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BASIC RIFLE MARKSMANSHIP SKILL RETENTION: IMPLICATIONS FOR RETENTION RESEARCH

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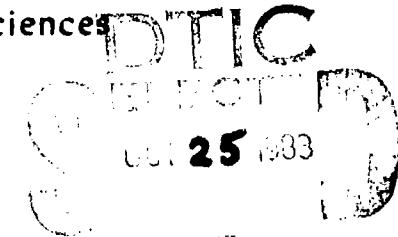


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20. (Continued)

provided skill mastery.

The attrition of subjects from all four training programs and control of experimental conditions proved to be problems in this effort. Future retention experimentation can benefit from the observations and findings during this research effort.

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FOREWORD

The Fort Benning Field Unit has been involved in research designed to improve Basic Rifle Marksmanship (BRM) training programs for a number of years. A major portion of this research effort has taken place at Fort Jackson, South Carolina at the US Army Training Center. This report presents the results and insights gained from a post-training retention test conducted in the summer of 1979. The results of this retention testing are important to the Army because they address a critical element of training which has been overlooked in the past. The retention of acquired skills is an emerging consideration for almost all training effectiveness analyses and evaluations the Fort Benning Field Unit presently plans.

It is obviously important that a training program possess the capability to train a soldier to develop, or acquire, a specific skill. A consideration which has in the past not received as much attention during training program development is subsequent retention of the skill. After the experiments with training programs at Fort Jackson, soldiers returned to the qualification ranges approximately six weeks later for retention firing. The results of this secondary testing are presented in this report.

Considerations for future retention testing, which focus on the atmosphere for long-term research in the military environment, are presented as well. There are a number of problems which arise from efforts to follow soldier subjects and training for extended periods of time which may be very unique to the military. The constant tendency to encounter change in command structures and programs challenges the scientist to plan carefully before undertaking a major piece of training research. A number of lessons were learned during this particular effort which can be generalized because of the environment of our work. The results presented, therefore, have potential influence beyond the marksmanship training area.



JOSEPH ZEITNER
Technical Director

BASIC RIFLE MARKSMANSHIP SKILL RETENTION: IMPLICATIONS FOR RETENTION RESEARCH

BRIEF:

The US Army Infantry School has sponsored Training Effectiveness Analysis (TEA) efforts in rifle marksmanship in order to improve training procedures and related doctrine. An extensive series of experiments conducted at Fort Jackson, South Carolina, by the Army Research Institute Fort Benning Field Unit focused on maximizing the effectiveness of Basic Rifle Marksmanship (BRM) Training. Candidate program components were developed and compared in a resource constrained training environment. A concern of the sponsors, the trainers, and the researchers was the retention of skills acquired during training by subjects in each of the respective programs. It was an important issue because the soldiers would not again practice marksmanship fundamentals until arriving at a unit of assignment many weeks later. Should one candidate program clearly provide enhanced skill retention, it would be advantageous to consider it as a model for the Army's Basic Rifle Marksmanship Program of Instruction.

Procedure:

Three experimental BRM training programs were developed and compared with the current standard program. The experimental programs differed in approaches to providing performance feedback to the firer and in instructor to student ratio on the firing line.

All subjects, in all training programs tested, fired a Record Qualification Course which was the standard end of training performance examination. The skill retention experiment retested all available subjects from the original training programs approximately six weeks after the completion of the BRM training program to note degradations in performance.

Findings:

The record fire scores of experimental programs were significantly better than those of the standard program in the initial qualification training. In the firing conducted to measure skill retention the significant differences which existed earlier were not found.

Future skill retention research conducted in field settings, it was found, must control all critical variables closely. Practical problems easily develop as a result of key personnel and subsequent training, environmental changes. Consistent command support is necessary during

any experiment to insure the stability of the project and this point cannot be overemphasized. This consistency combined with subject stability and design simplicity are key to a successful data collection effort over time.

The results of the experimental work performed at Fort Jackson, and reported previously in detail, will continue to influence Basic and Advanced Rifle Marksman ship program refinement. The results from the retention experiment will be used to influence future training program developments as well as serve as an experience base for future skill retention research.

BASIC RIFLE MARKSMANSHIP SKILL RETENTION: IMPLICATIONS FOR RETENTION RESEARCH

CONTENTS

	Page
INTRODUCTION	1
METHOD	2
Subjects	2
Procedure	2
RESULTS	3
Training Attendance	5
Retention Delay Periods	5
Performance Data	6
DISCUSSION AND CONCLUSIONS	11
Zeroing Performance Comparison	11
Qualification Performance	11
Performance Declines	11
Retention Testing Problems	12
Recommendations and Conclusions	13
REFERENCES	15

TABLES

Table 1. Male and Female Trainees Assigned to Each Treatment Group	3
2. Retention Subject Assignment	4
3. Male and Female Subjects Available for Retention Firing	5
4. Training Sequence and Firing Schedule	6
5. Mean Number of Target Hits of Retention Subjects and Paired <u>t</u> Test Results	7
6. Comparison of Retention Performance Scores for Males and Females Who Completed All Training and Who Missed Some Training	8

TABLES (Continued)	Page
Table 7. Analyses of Variance of Retention Firing Scores for Subjects Completing All Training	9
8. Within Subjects Changes Record Fire to Retention Fire	10
9. Declines in Performance for All Retention Subjects . .	10

BASIC RIFLE MARKSMANSHIP SKILL RETENTION: IMPLICATIONS FOR RETENTION RESEARCH

INTRODUCTION

Part of the Basic Rifle Marksmanship (BRM) research conducted during 1979 by the US Army Research Institute, Fort Benning Field Unit (ARI-Benning) included a planned effort to examine skill retention as the final part of a major field experiment. This retention research followed the work begun under the sponsorship of the US Army Infantry School (USAIS) for the purpose of developing and implementing improved marksmanship programs at basic, advanced, and unit levels. The retention research being reported followed an experiment conducted at Fort Jackson, South Carolina, that was designed to test program improvements for Basic Rifle Marksmanship (BRM) training.

The research conducted at Fort Jackson compared candidate components in total programs which had been independently developed in previous research. Earlier research showed that typical marksmanship training did not provide adequate performance feedback and clear information regarding marksmanship fundamentals (Evans, Thompson & Smith, 1980; Osborne, Morey & Smith, 1979; Smith, Thompson, Evans, Osborne, Maxey & Morey, 1980). These critical components and others relevant to the development of improved BRM programs were compared in the field study conducted at Fort Jackson (Thompson, Smith, Morey & Osborne, 1980). The objective was the comparison of three candidate training programs, developed from individual components previously tested, with another one being taught as the US Army standard program. Primarily, each program was equivalent in length but differed in the manner in which performance feedback was provided and in the number of trained cadre present on the firing line. The test was conducted, with command support from the US Army Training Center, Fort Jackson, by ARI-Benning during the spring and early summer of 1979. A second firing for record took place during the summer of 1979 to measure skill retention resulting from the training received in the spring.

The retention of learned skills is a critical objective of military training. The performance of a soldier is important during training, or acquisition, but a primary purpose of training must be to impart skills which the individual will be able to use with sometimes infrequent practice. Marksmanship is just such a skill. Soldiers are not typically permitted regular range practice to maintain shooting skills. One of the test objectives of this experiment (Smith, et al., 1980) was to compare the skill retention of subjects in all four programs at a fixed interval after initial training. The results of the retention phase of the program comparison are presented in this report. A number of problems were anticipated in collecting skill retention data after the completion of the major portion of the BRM program experiment. Turnover in cadre, lack of knowledge and interest by Advanced Individual Training (AIT) cadre, and difficulty in tracking trainees from basic training to advanced training at Fort Jackson were expected. Detailed plans were made by ARI-Benning and the

Basic Training Committee Group and disseminated to counter any negative impact on the experiment. Still unanticipated problems were encountered which had substantial influence on the conduct of the retention data collection program.

An important element of the entire BRM field experiment was the emphasis placed on the importance of trainees' total participation to determine the effects of the training. The training committee commander provided detailed instructions not only to the cadre assigned to provide training, but to everyone post-wide involved with the experiment at Fort Jackson. The instruction emphasized the importance of being present for training and for being present at retention testing six weeks later.

This report has a twofold purpose. The first is to present the data obtained during the retention phase and discuss the relationship of the results to the training programs tested. The second purpose is to present a summary of the problems encountered during this phase of testing and the relevant implications for future retention testing. Retention of acquired skills research has obvious importance to military training. An initially expensive and lengthy training program may permit longer intervals between refresher training periods to maintain proficiency and, therefore, be a more training and cost effective program than another apparently less expensive one. This part of the BRM experimental work, the skill retention data collection phase, provided a number of insights into the practical problems of skill retention efforts in the field.

METHOD

Subjects

Of the 1,151 subjects (910 males and 241 females) who were members of eight basic training companies participating in the BRM training program comparison, a total of 388 subjects (266 males and 122 females) were retained and available for retention firing. These subjects could not be randomly selected, but instead represented every available BRM test subject assigned to Advanced Individual Training at Fort Jackson after the completion of Basic Training who could be traced through record searches during June and July.

Procedure

The retention phase of the BRM experiment called for repetition of the record fire qualification course six weeks after initial firing. Firing took place on the same automated trainfire ranges used for record qualification firing to minimize scoring errors common to record fire courses using troops as lane graders. The automated range insured the same target sequence and time of exposure for the 40 exposure firing table for both firings.

The sequence of events related to the retention record fire was:

- o The identification by the BT committee of all BRM test subjects assigned to receive AIT at Fort Jackson.
- o The return of identified subjects six weeks after their qualification firing for retention testing.
- o The firing of three zeroing shot groups by each subject on the 25-meter firing range.
- o The firing of the Record Qualification Course.

Skill retention was determined by comparisons of performance, or number of targets hit, on the original qualification course with performance on the second six weeks later.

RESULTS

The number of male and female trainees who completed all or part of the training in each of the original treatment groups is shown in Table 1. Completion of all or some training became a variable which contributed to differences in Record Fire Qualification firing.

Table 1
Male and Female Trainees Assigned to Each Treatment Group

Program	Males	Females	Total Subjects
I (Standard)	229	58	287
II	246	75	321
III	224	60	284
IV	<u>211</u>	<u>48</u>	<u>259</u>
Total	910	241	1,151

Of the 1,151 subjects in the BRM Program comparison, 388 (33.71%) were identified as having been retained in AIT at Fort Jackson for participation in the retention phase of the test. The distribution of these trainees, by their initial BRM training program, is presented in Table 2. Attrition was expected since many soldiers normally transfer to other posts for AIT. Clerical skills AIT soldiers and some cooks are the primary groups retained at Fort Jackson.

Table 2
Retention
Subject Assignment

Training Program	BRM Test N	Retention N	Percent Retained
I (Standard)	287	99	34%
II	321	119	37%
III	284	102	36%
IV	<u>259</u>	<u>68</u>	<u>26%</u>
	1151	388	33.71%

The performance scores on the Record Fire Qualification Course during the BRM Program Comparison of these subjects did not differ significantly from the total sample in each program. For each track a comparison between the mean record fire scores of the full sample and the retention subsample revealed that the retention subjects were representative of the full sample, since z values were in the range -1.75 to 1.31 (all nonsignificant at the .05 level for a two-tailed test).

Relatively large samples of both male and female subjects were available from all four training programs for initial BRM performance data collection. However, the reduction in subjects available for retention testing, particularly those having completed all periods of BRM training, limited the data analysis considerably.

Training Attendance

Test soldier participation in all periods of instruction was considered an important element in conducting meaningful comparisons of program effectiveness and skill retention. Table 3 presents the number of subjects, by program, who were retained as well as those specifically who attended all training. Attendance had been emphasized for all training periods and for the retention firing (HQ USATC, Fort Jackson, South Carolina, 1979). The data point out that, even with command emphasis, a serious problem existed. The number of subjects retained who had attended all training was so small that in most cases extensive retention comparisons were difficult. For example, Program IV had only five females retained who had attended all training (see Table 3).

Table 3

Male and Female Subjects Available for Retention Firing

Program	Males	Females	Total Subjects
I (Standard)	63 (19)	36 (22)	99 (41)
II	85 (53)	34 (21)	119 (74)
III	74 (50)	28 (14)	102 (64)
IV	44 (29)	24 (5)	68 (34)
	266 (151)	122 (62)	388 (213)

Note: The number in parentheses () is the number of trainees retained who had attended all training.

Retention Delay Periods

The planned interval between record qualification firing and retention firing for subjects in all programs was originally six weeks. This period of time permitted trainees to complete basic training and critical phases of AIT without training schedule interruptions. From a practical standpoint, this interval was a training resource management decision as well as an experimental design decision. It was anticipated that acquired marksmanship skills would show some decay by this point. This interval would also provide an indication of which training program provided the best skill retention over a controlled

period of time. It was reasonable to assume that the typical soldier, once trained, could not be expected to fire a weapon again until having reached a field unit. The original test plan called for a six week interval while actual time between firings differed from one training company to another. Minor scheduling difficulties, once the program test began and the decision made by USATC, Fort Jackson, to conduct all retention firing on Saturdays, caused this change. The Saturday selected was the one closest to six weeks from the company's qualification firing. Table 4 presents the program test groups, record qualification firing dates, and retention firing dates for all training companies involved in the experiment.

Table 4
Training Sequence and Firing Schedule

Company	Program	Record Fire Date	Retention Fire Date	Interval Between Firings
B-8-2	III*	2 May	16 June	6 wks 4 days
A-8-2	III	7 May	16 June	5 wks 6 days
D-8-2	III	11 May	23 June	6 wks 2 days
E-8-2	II	11 May	23 June	6 wks 2 days
C-8-2	II	14 May	30 June	6 wks 6 days
B-3-1	IV	18 May	7 July	7 wks 2 days
C-3-1	I	18 May	7 July	7 wks 2 days
A-3-1	I	21 May	7 July	6 wks 6 days
C-9-2	IV	30 May	14 July	6 wks 4 days

* B-8-2 was used as a pretest group to exercise the administration of the new program components.

Performance Data

The prime data for performance comparison were the number of target hits on the 40 exposure record fire course fired twice by each retention subject, once during initial training and once during the retention testing phase.

The differential effects of weather and firing lane assignments could not be controlled.

Table 5 presents the mean number of target hits for record fire conducted approximately six weeks earlier by subjects in each training program and their subsequent retention firing scores. The results of retention firing for all four programs show performance decay over time. One-tailed t tests for paired observations (Table 5) revealed significant performance decreases for all training programs. While the performance results of the standard program (Program I) indicate the smallest loss with an average of 1.8 fewer target hits during the retention firing than during qualification firing, these subjects also achieved the lowest average record fire score.

Table 5
Mean Number of Target Hits of Retention Subjects
and Paired t Test Results

Program	N	Mean Record Fire Score	Mean Retention Score	t	df	P
I	99	20.54	18.74	1.97	98	<.025
II	119	24.02	21.89	2.83	119	<.0025
III	102	25.83	21.21	5.78	101	<.0005
IV	68	22.53	19.81	2.39	67	<.01

Note: Maximum score is 40.

Performance differences were found between subjects who had attended all training and those who had missed some training. Table 6 presents comparisons of the mean number of hits of retained subjects who had attended all initial training with those of retained subjects who had missed some BRM training. A series of independent group t tests demonstrated that while performance scores for subjects having had all training and those having missed some training differed, the differences were not significant.

Table 6

Comparison of Retention Performance Scores for Males and Females
Who Completed All Training and Who Missed Some Training

Program	Males						Females					
	Mean Reten All Tng (N)	Mean Reten Some (N)	t	df	p	Mean Reten All Tng (N)	Mean Reten Some (N)	t	df	p		
I	21.53 (19)	20.11 (44)	<1	61	NS	14.73 (22)	16.93 (14)	<1	34	NS		
II	23.87 (53)	21.13 (32)	1.63	83	<.2	18.48 (21)	21.23 (13)	1.15	32	<.2		
III	22.62 (50)	24.04 (24)	<1	72	NS	16.79 (14)	16.79 (14)	0	26	NS		
IV	21.55 (29)	19.80 (15)	<1	42	NS	18.40 (5)	17.53 (19)	<1	22	NS		

Note: Numbers in parentheses are number of subjects.

Previous field experimentation has shown that males generally produce higher record fire scores than females in marksmanship training (Smith et al., 1980). This finding was supported in the Fort Jackson BRM Program test results (see Table 4, Thompson, et al., 1980) where an analysis of variance of record fire scores resulted in significant main effects for programs, $F(3,634 = 25.24$, $p<.0001$, and for sex, $F(1,634 = 14.00$, $p<.0001$, but no significant interaction, ($F<1$).

Separate comparative analyses of variance of retention scores among programs were conducted for male and female retention subjects who completed all training (Table 7). No significant differences were found among retention scores to suggest a clear advantage, in terms of skill retention, for any of the compared training programs.

Table 7
Analyses of Variance of Retention Firing Scores
for Subjects Completing All Training

<u>Male Subjects</u>				
<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Between	3	45.663	.897	NS
Within	<u>147</u>	50.910		
Total	150			
<u>Female Subjects</u>				
<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Between	3	55.404	.985	NS
Within	<u>58</u>	56.227		
Total	61			

The mean performances were based on generally small and unequal numbers of subjects and sometimes exaggeratedly so. There were, for example, 54 Program II males who had attended all training while there were only 5 females in Program IV who attended all training (Table 6). The suitability of the performance data collected is therefore questionable. These reservations extend to the t tests and ANOVAs in Tables 6 and 7 as well.

Considering all subjects retained, performance changes occurred in all four programs. Table 8 presents the directional changes for these subjects. One-third of the subjects across programs obtained higher numerical scores during the retention phase firing than they did during the original qualification firing. Sixty percent had poorer scores during the retention firing. The mean scores for males and females in all programs changed after the six week interval between record fire tables (Table 9).

Table 8
Within Subjects Changes Record Fire to Retention Fire

Program	Retention > Record	Retention = Record	Retention < Record	Total N
I	37 (37.4%)	8 (8.1%)	54 (54.5%)	99
II	43 (36.1%)	8 (6.7%)	68 (57.1%)	119
III	23 (22.6%)	7 (6.8%)	72 (70.6%)	102
IV	<u>25</u> (36.8%)	<u>4</u> (5.9%)	<u>39</u> (57.3%)	<u>68</u>
	129	27	233	388

The declines in performance from the original record firings for males and females in all four programs are presented in Table 9. While earlier analyses (Tables 6 and 7) dealt with the performance of subjects who attended all training, all retention subjects are included in Table 9 to show total percentage losses in performance.

Table 9
Declines in Performance for All Retention Subjects

Program	N		Record Fire Mean	Retention Fire Mean	Percentage of Performance Loss
I	63	Males	21.54	20.54	4.64%
	36	Females	18.88	15.58	17.02%
II	85	Males	24.52	22.84	6.86%
	34	Females	22.77	19.53	14.22%
III	74	Males	26.80	23.08	13.87%
	28	Females	22.64	16.79	25.87%
IV	44	Males	24.95	20.95	16.03%
	<u>24</u>	Females	18.08	17.71	2.07%
	388				

DISCUSSION AND CONCLUSIONS

Zeroing Performance Comparisons

Comparisons of zeroing performance between the original training and zeroing preceding retention firing had been planned. Drill sergeants from the subjects' AIT units, sent to monitor the subjects while on the range, were not familiar with the appropriate range procedures though knowledge of test procedures for them had been previously emphasized (HQ, USATC, Fort Jackson, 1979). The range personnel did not enforce the predetermined policy which required each subject to fire and mark three complete three-round shot groups for zeroing. In many cases only one shot group was actually fired when a subject's rifle appeared zeroed. In part, range activities were driven by implied time constraints since most of the personnel involved, including range NCOs, drill sergeants, and subjects would have been off duty had they not been assigned to this test activity.

Qualification Performance

Retention firing was conducted each weekend on the same automated scoring ranges that were used for initial Record Fire Qualification. Subjects were moved from a 25 meter firing range, where zeroing took place, to the Record Fire Qualification range for qualification firing. With the exception of the retention firings conducted on 23 June, the weather for all retention firing was adequate. On 23 June (companies D-8-2, Program III; and E-8-2, Program II) firing had to be halted frequently due to target obscurations resulting from heavy rainfall. The range NCOs in charge were hesitant to halt the firing. Whether this hesitancy could be attributed to a desire to complete the firing or to a concern that they did not have the authority to halt firing is not certain. A decision to temporarily halt firing, based on ARI influence, occurred while one order was firing a foxhole supported engagement sequence with targets beyond 200 meters obscured. Firing stopped immediately and was resumed when visibility improved. The average scores for the two companies involved were almost identical (D-8-2, Program III, mean hits = 21.15; E-8-2, Program II, mean hits = 21.35). While the other two companies representing training programs II and III did not produce significantly better results (C-8-2, Program II, mean hits = 23.62; A-8-2, Program III, mean hits = 21.95), the lower scores from the two companies which fired in the rain, however, probably harm the performance trends of these programs.

Performance Declines

The retention performance scores of subjects were generally poorer than the record fire qualification scores with females having a greater rate of decline than males in all but one group. While some individuals performed better during retention firing than they did during the post training record

fire, the majority had lower scores. Overall, male scores declined an average of 10.16 percent from their previous record fire scores. Females, with lower average scores on record fire initially, also appeared to retain less skill. Across programs the average decline for females between performances was 15.30 percent.

In all, the retention scores for 33.16 percent ($N=129$) of the subjects were higher than, 6.94 percent ($N=27$) were equal to, and 59.90 percent ($N=233$) were less than, the original record fire scores. While performance in all four programs declined over time, the percentage of decline differed across programs and differed considerably between male and female subjects within programs.

Mean record fire qualification course scores for male subjects in the experimental programs (II, III, & IV) showed a greater percentage of decline over time than did the mean performance for Program I (Standard). As compared to standard program males performance, the initial scores on record fire for males in the experimental programs were higher but had associated higher rates of decline. While the experimental programs produced better performance results than the standard program (Thompson, et al., 1980), record fire performance comparisons indicated that there was no clear superiority for any one of the experimental programs. The results of the retention performance comparisons provided no significant differences either. While Program III produced the highest retention mean score (23.08) for males, this was not significantly different from other program means. Female declines were not as clearly defined. The percentage of performance decline for female subjects in Program III was highest (24.87%) and yet the mean retention score for females was still higher than that of the standard program (16.79 vs. 15.58).

The limited decline in performance over time associated with the standard program is attributed to an initial shortcoming in training. The greater decline in performance over time found generally with the experimental programs indicated greater initial acquisition but suggest insufficient training to insure skill retention.

Retention Testing Problems

The initial plans for the BRM program comparison included retention testing. This phase did not receive constant scrutiny before and during the test as did the conduct of the experimental programs. Primarily, the reasons for this were the simplicity of the retention testing requirements and the perception of the cooperation and understanding of test objectives by the cadre at Fort Jackson. The people responsible for training the experimental programs and operating range facilities knew their jobs well. The anticipated problems which appeared included managing records and locating test subjects for appropriate firing periods once the subjects were in AIT.

Prior to and during the program comparison test a tremendous amount of command emphasis was placed on marksmanship training on the retention test. However, key command personnel of the committee group changed during the completion of the experimental training and record fire phases of the test. While the new commander expressed support for the objectives of the test and insured the full cooperation of his staff, there was a shift in priorities and cadre attitudes observed during subsequent visits for retention data collection throughout the summer. Staff members who were tasked to locate test subjects attending AIT coordinated record searches with difficulty since the test records keeping was time consuming and not a primary staff responsibility. Also, the test was no longer the focus of the command, whereas training in a more traditional sense was. Range personnel tended to focus more on their training mission and less on the test objectives.

The changes in cadre priorities and attitudes were mirrored by the test subjects. Subjects who were trainees during the BRM phase were now students in AIT and projected a much more relaxed image. The relaxed attitudes appeared amplified by the fact that retention firing took place on Saturdays.

The attitude which emerged from many of the personnel concerned--subject soldiers, drill sergeants, and range NCOs--was that the only task on the assigned Saturday for retention testing was to complete firing quickly and have the remainder of the day off. This approach contributed to hasty and incomplete zeroing on the 25 meter range. Cadre from the AIT units had not been told the purpose of the test before getting to the range and assumed that the best approach was to "move them through." ARI-Benning with one researcher available to monitor all range activities during retention testing could not slow range activities which appeared to be driven by desires to finish.

Recommendations and Conclusions

The results of the retention phase have shown that the experimental training programs produced higher mean retention scores as well as higher mean initial record fire scores (Table 5). However, the six-week interval between firings eliminated the significance of the performance differences among the experimental and standard programs for both male and female subjects. It is generally concluded that while the experimental programs improved marksmanship performances and subsequent retention performance, they did not train the subjects sufficiently to acquire skill mastery.

Future skills retention research, to be valid, must be conducted in field settings. It is often extremely difficult to control all critical variables in the field, particularly when experiments are protracted over extensive periods of time as retention efforts must be. Consideration must be given to the following practical problems which go beyond traditional control of variables for experimental procedures to derive benefit from appropriate research efforts:

o Command stability for the duration of a project is critical. Changes at a command level that can possibly influence the conduct or outcome of an ongoing research program will, by its very nature, cause a change. This impacts on support to the research effort.

o Subject stability is important. It may not be practical to expect undisrupted subject pools during the course of an experiment using military subjects. This experiment retaining 34 percent of its subjects may be typical, or possibly represent a fortunate extreme.

o Procedural simplicity that can be clearly communicated to all personnel is particularly encouraged.

o Broad dissemination of the objectives of the research is necessary. In the case of the current marksmanship skill retention work, it would have been helpful to have had the AIT drill sergeants understand in advance the reason for being on the range on Saturdays. Information dissemination through command channels to all lower levels should be encouraged prior to conducting research. The influence and support of the appropriate commander must be understood by staff officers and test personnel to insure cooperation at the worker level.

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